Obturation Of The Root Canal System

Objectives Of Obturation:

(1) To prevent nutritional elements from accessing the pulpal space along any entrance to the root canal space, including apical foramina, accessory canals and the oral access cavity.

(2) To eliminate space for further growth of microorganisms that may have survived the biomechanical preparation.

WHEN TO OBTURATE THE CANAL:

1. The tooth should be asymptomatic
2. Canal is dry
3. No sinus tract
4. No foul odor
5. Negative culture test
6. No tenderness on palpation to oral mucosa
7. Intact temporary filling

OBTURATION TECHNIQUES:

Different approaches to obturation can be used, depending on the size of the prepared canal, the final shape of the preparation, and irregularities within the canal. The overriding factor is clinician preference; no technique has been shown to be superior with regard to long-term outcomes.

lateral condensation	• cold • warm
warm vertical condensation	
continuous wave compaction technique	
thermoplastic injection technique	• obtura III • ultrafil 3D
carrier based guttapercha	• themafil • successfil • simplifil
themomechanical compaction	
solvent technique	
pastes	
immediate obturation	

1) Lateral Compaction

Lateral compaction is a common method for obturation. The technique can be used in most clinical situations and provides for predictable length control during compaction. A disadvantage is that the technique may not fill canal irregularities as well as warm vertical compaction or other thermoplastic techniques. The procedure can be accomplished with any of the acceptable sealers. This "master cone" is measured and grasped with forceps so that the distance from the tip of the cone to the reference point on the forceps is equal to the prepared length. A reference point on the cone can be made by pinching the cone. The cone is placed in the canal, and if an appropriate size is selected, there will be resistance to displacement or "tug back." If the cone is loose it can be adapted by removing small increments from the tip. Devices are available to cut cones accurately at a predetermined length (Tip Snip; SybronEndo). If the master cone fails to go to the prepared length, a smaller cone can be used. When the cone extends beyond the prepared length a larger cone must be adapted or the existing cone shortened until there is resistance to displacement at the corrected working length. The master cone placement is confirmed with a radiograph. The canal is irrigated and dried with paper points. Sealer is applied to the canal walls, and a spreader is prefitted so as to allow it to be inserted to within 1 to 2 mm of the working length. Appropriately sized accessory points are also selected to closely match the size of the spreader. Finger spreaders provide better tactile sensation and are less likely to induce fractures in the root when compared with the more traditional hand spreader. Spreaders made from nickel-titanium are available and provide increased flexibility, reduced stress, and provide deeper penetration when compared with stainless steel instruments. The spreader should fit to within 1 to 2 mm of the prepared length, and when introduced into the canal with the master cone in place, it should be within 2 mm of the working length. There appears to be a correlation between the establishment of a higher quality seal and the depth of spreader penetration. After the spreader has been placed to its maximum depth, it is removed by rotating it back and forth as it is withdrawn. An accessory cone is placed in the space vacated by the spreader. The process is repeated until the spreader no longer goes beyond the coronal one third of the canal. The excess gutta-percha is removed with heat and the coronal mass is compacted with an appropriate unheated plugger. The excess gutta-percha in the chamber is then seared off and vertically compacted with a heated plugger at the orifice or approximately 1 mm below the orifice in posterior teeth. In anterior teeth, the desired level is the cementoenamel junction on the facial surface to avoid aesthetic issues. Warm vertical compaction of the coronal gutta-percha enhances the seal. Only light pressure is required during lateral compaction because the gutta-percha is not condensed, and because as little as 1.5 kg of pressure is capable of fracturing a root. In addition to the force applied, investigators have noted that removal of excessive amounts of dentin during preparation is a significant factor in root fracture. A disadvantage to lateral compaction is that the process does not produce a homogeneous mass. The accessory and master cones are laminated and remain separate. It is envisaged that the space between each of the cones is filled with sealer to aid in establishment of a water-tight seal.

2) Warm Lateral Compaction

Warm lateral compaction of gutta-percha provides predictable length control, which is an advantage over thermoplastic techniques. The Endotec II device (Medidenta, Las Vegas,Nevada) provides the clinician with the ability to employ length control while incorporating a warm gutta-percha technique. The warm lateral compaction technique involves adapting a master cone in the same manner as with traditional lateral compaction. An appropriate-size Endotec II tip is selected. Endotec II tips are available in various taper and tip diameters. The device is activated and the tip is inserted beside the master cone to within 2 to 4 mm of the apex, using light pressure. The tip is rotated for 5 to 8 seconds and removed. An unheated spreader can be placed in the channel created to ensure adaptation and then an accessory cone is placed. The process is continued until the canal is filled.

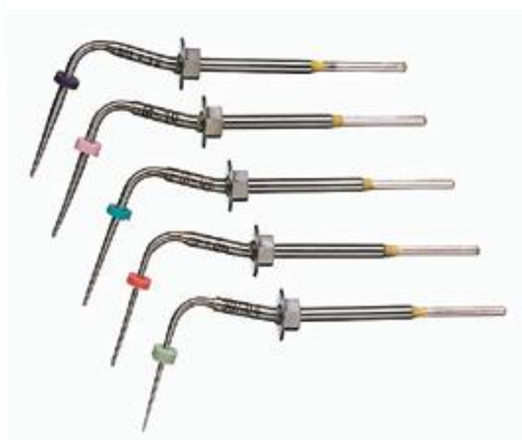
3) Warm Vertical Compaction

Vertical compaction is also an effective but more complex technique; its seal-ability is comparable to that of lateral compaction. The principal advantage of vertical compaction over lateral compaction is the ability to adapt the warmed and softened gutta-percha (GP) to the irregular surface architecture of the root canal. Disadvantages include increased difficulty of length control, a more complicated procedure, and a larger assortment of required instruments. Also, a somewhat larger canal preparation is necessary to allow insertion of the instruments to the required depths.

The technique involves fitting a master cone short of the prepared working length (0.5 to 2 mm) with resistance to displacement. This ensures that the cone diameter is larger than the prepared canal at the terminus. After the adaptation of the master cone, it is removed and sealer is applied to the cone and the walls of the prepared canal. The cone is placed in the canal and the coronal portion is removed with a heated instrument. A heated spreader or plugger is used to remove portions of the coronal gutta-percha in successive increments and soften the remaining material in the canal. The Touch ’n Heat (SybronEndo) , DownPak (Hu-Friedy, Chicago, Illinois), and System B (SybronEndo) are alternatives to applying heat with a flame-heated instrument because they permit improved temperature control. A cold plugger is inserted into the canal and the gutta-percha is compacted, forcing the plasticized material apically. The process is repeated until the apical portion has been reached. The coronal canal space is back-filled using small preheated pieces of gutta-percha. The sectional method consists of placing 3- to 4-mm sections of gutta-percha approximating the size of the canal into the root, applying heat, and compacting the mass with a plugger.

4) Continuous Wave Compaction Technique

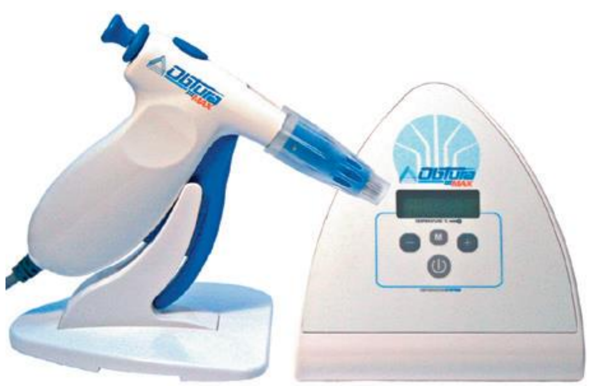
A variation of warm vertical compaction is the continuous wave compaction technique. The technique is often used after preparation with nickel-titanium rotary files of greater taper. The continuous wave compaction technique employs the System B connected to 0.04, 0.06, 0.08, 0.10, or 0.12 tapered stainless steel pluggers.



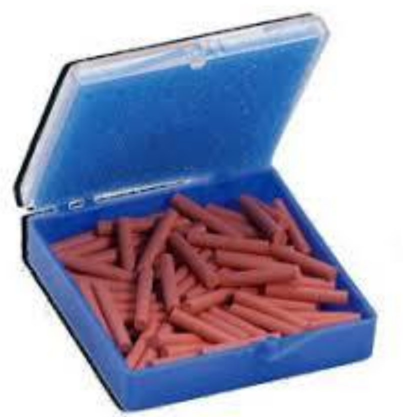
The electric heat source permits a variable temperature setting. The recommended temperature setting for the System B unit is 200° C. After selecting an appropriate master cone, a plugger is prefitted to within 5 to 7 mm of the prepared length. The plugger is inserted into the canal orifice and activated to remove excess coronal material. Compaction is initiated by placing a cold plugger against the gutta-percha at the canal orifice. Firm pressure is applied and heat is activated with the device. The plugger is moved rapidly (1 to 2 s) to within 3 mm of the binding point. The heat is inactivated while firm pressure is maintained on the plugger for 5 to 10 seconds. After the gutta-percha mass has cooled, a one-second application of heat separates the plugger from the gutta-percha and it is removed. Filling the space left by the plugger may be accomplished by a thermoplastic injection technique or by fitting an accessory cone into the space with sealer, heating it, and compacting by short applications of heat and vertical pressure.

5) Thermoplasticized Injection Technique

For thermoplasticization injection, specially formulated GP is warmed in injection devices and then injected. When used in conjunction with a sealer, thermoplasticized injection provides an adequate seal. This technique is useful in special situations; like internal resorption. However, lack of length control and shrinkage on cooling are potential disadvantages. This is a technique-sensitive methodology.



Obtura III devise

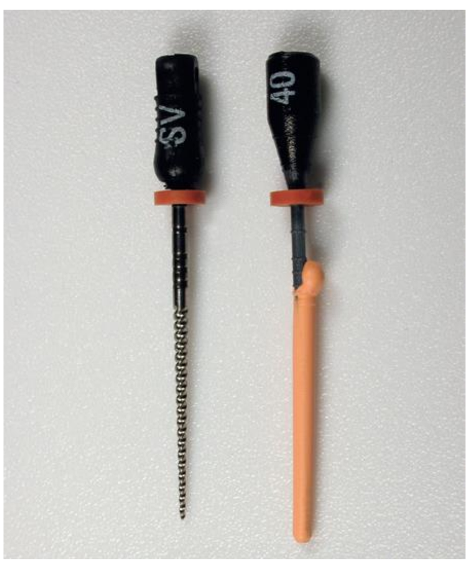


gutta-percha

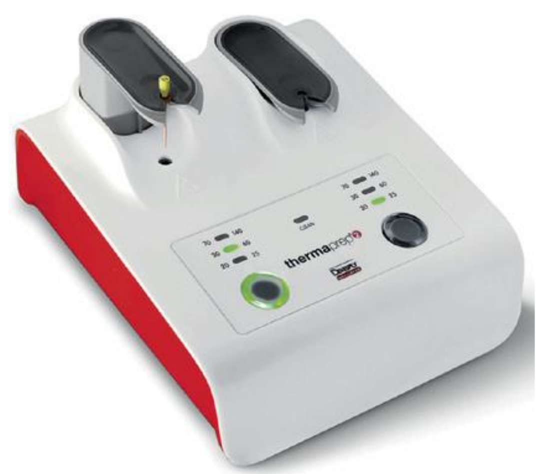
6) Carrier-Based Gutta-Percha technique

The systems consist of a plastic core coated with α-phase gutta-percha called Obturator, and a heating device that controls the temperature. Obturators are designed to correspond to the ISO standard file sizes and variable tapered nickel titanium rotary files. Size verifiers are available to aid in selection of the appropriate carrier and should fit passively at the corrected working length. After drying the canal a light coat of sealer is applied and a carrier is marked, set to the predetermined length. The carrier is disinfected with 5.25% NaOCl for 1 minute and rinsed in 70% alcohol.

The carrier is then placed in the heating device. When the carrier is heated to the appropriate temperature, the clinician has approximately 10 seconds to retrieve it and insert it into the canal. This is accomplished without rotation or twisting. Evidence suggests that the insertion rate affects the obturation. The fill length and obturation of irregularities increase with increasing insertion rates. A rapid insertion rate enhances obturation. The position of the carrier is verified radiographically. The gutta-percha is allowed 2 to 4 minutes to cool before resecting the coronal portion of the carrier, which can be several millimeters above the canal orifice. This is accomplished by applying stabilizing pressure to the carrier and cutting the device with an inverted cone, round bur, or a specially designed Prepi bur (DENTSPLY Tulsa Dental Specialties). Heated instruments are not recommended for this process because this may result in displacement. Vertical compaction of the coronal gutta-percha can then be accomplished. When necessary, gutta-percha can be added, heat softened, and compacted. An advantage to this technique is the potential for movement of gutta-percha into lateral and accessory canals; however, extrusion of material beyond the apical extent of the preparation is a disadvantage.



Thermafil carrier and size verifier



The Thermafil oven with carrier in place

7) Thermomechanical Compaction Technique

McSpadden introduced an instrument, the McSpadden Compactor, with flutes similar to a Hedstrom file but in reverse. When activated in a slow-speed handpiece, the instrument would generate friction, soften the gutta-percha, and move it apically. Advantages include simplicity of the armamentarium, the ability to fill canal irregularities, and time. Disadvantages include possible extrusion of material, instrument fracture, gouging of the canal walls, the inability to use the technique in curved canals, and possible excessive heat generation.

8) Solvent technique

Solvent techniques involve the total or partial dissolution of GP in solvents, primarily chloroform or eucalyptol. These techniques have names such as chloropercha, eucapercha, diffusion technique, or chloroform resin. Often these techniques are not used in conjunction with a standard sealer, but rather depend on softened GP to closely adapt to the wall of the RCS. The problem is that GP shrinks away from the walls as the solvents evaporate. Extensive leakage is generally seen with these techniques, resulting in a poorer long-term prognosis. *Solvent techniques are not recommended.*

9) Pastes

It seemed like a great idea: why not develop a paste or cement with bioactive ingredients? This material could be mixed in a liquid or putty form and injected to the WL, obturating the entire RCS, and then allowed to set. The process would be faster, the paste would fill the entire canal space, and obturation would be much simpler.

Although the concept is appealing, there are significant practical difficulties. The major disadvantages with the use of paste materials are lack of predictable length control, shrinkage, toxicity of ingredients, preclinical difficulties in introduction of the material without voids, and resorbability of the materials. *Paste filling is not recommended.*

10) Immediate Obturation

Immature teeth exhibiting pulp necrosis or teeth with apical resorption traditionally were treated with calcium hydroxide to establish an apical barrier (apexification) before obturation. Studies have demonstrated that teeth treated with calcium hydroxide for prolonged periods are more susceptible to fracture. Immediate obturation is an alternative to apexification. An apical barrier material should confine obturation materials to the canal space and enhance healing by inducing cementum and bone formation. Mineral trioxide aggregate (MTA) has been successfully employed as an apical barrier material before obturation. After cleaning and shaping procedures, the root canal system is dried and a small increment of MTA is placed to the radiographic apex and the location verified through a radiograph. If the material is overextended, it can be easily irrigated out with sterile saline. If it is short of the radiographic apex, it can be compacted with prefitted pluggers to move it to the radiographic apex. The material is compacted into the apical portion of the root to form a barrier. After the material sets, any thermoplasticized technique can be used to backfill with gutta-percha without concern of overextension.

❖ CORONAL ORIFICE SEAL

No matter which technique is used to obturate the canals, coronal microleakage can occur within a short time through seemingly well-obturated canals, potentially causing infection of the periapical area. Early research efforts focused on the quality of the seal in the apical part of the root canal system to prevent percolation of apical fluids. However, contemporary research efforts have identified the greater importance of maintaining a coronal seal to prevent bacterial leakage. Leakage studies indicate that the coronal seal can be enhanced by the application of supplemental restorative materials over the canal orifice and by placing a definitive coronal restoration as soon as is feasible. A glass ionomer or resin-modified glass ionomer cement can be used. Alternatively, a self-etching dentin adhesive and a flowable resin composite may be used. A material with a different color than dentin may be used for identification, in case subsequent placement of a post is required.